ESSENTIAL FISH HABITAT ASSESSMENT REPORT

for the Bering Sea and Aleutian Islands

King and Tanner Crabs

Prepared by

National Marine Fisheries Service
Alaska Department of Fish & Game
North Pacific Fishery Management Council

Compiled by
The Technical Team for Essential Fish Habitat
for King and Tanner Crabs in the Bering Sea and Aleutian Islands

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for the Crab Resources
of the Bering Sea/Aleutian Islands Region

by
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INTRODUCTION

In 1996, the Sustainable Fisheries Act amended the Magnuson-Stevens Fishery Conservation and Management Act to require the description and identification of essential fish habitat (EFH) in fishery management plans (FMPs), adverse impacts on EFH, and actions to conserve and enhance EFH. Guidelines were recently developed by the National Marine Fisheries Service (NMFS) to assist Fishery Management Councils (Councils) in fulfilling the requirements set forth by the Act. In addition, the Act requires consultation between the Secretary and Federal and state agencies on activities that may adversely impact EFH for those species managed under the Act. It also requires the Federal action agency to respond to comments and recommendations made by the Secretary and Councils.

Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

After reviewing the best available scientific information, and in cooperation with the Councils, participants in the fishery, interstate commissions, Federal agencies, state agencies, and other interested parties, NMFS will develop written recommendations for the identification of EFH for each FMP. Prior to submitting a written EFH identification recommendation to a Council for an FMP, the draft recommendation will be made available for public review and at least one public meeting will be held. NMFS will work with the affected Council(s) to conduct this review in association with scheduled public Council meetings whenever possible. The review may be conducted at a meeting of the Council committee responsible for habitat issues or as a part of a full Council meeting. After receiving public comment, NMFS will revise its draft recommendations, as appropriate, and forward written recommendation and comments to the Council(s).

EFH Regulations Set Forth in the Guidelines

Habitat Requirements by Life History Stage

All FMPs must describe EFH in text and with tables that provide information on the biological requirements for each life history stage of the species. These tables should summarize all available information on environmental and habitat variables that control or limit distribution, abundance, reproduction, growth, survival, and productivity of the managed species. Information in the tables should be supported with citations.

Description and Identification of EFH

An initial inventory of available environmental and fisheries data sources relevant to the managed species should be useful in describing and identifying EFH. This inventory should also help to identify major species-specific habitat data gaps. Deficits in data availability (i.e., accessibility and application of the data) and in data quality (including considerations of scale and resolution; relevance; and potential biases in collection and interpretation) should be identified.

To identify EFH, basic information is needed on current and historic stock size, the geographic range of the managed species, the habitat requirements by life history stage, and the distribution and characteristics of those habitats. Information is also required on the temporal and spatial distribution of each major life history stage (defined by developmental and functional shifts). Since EFH should be identified for each major life history stage, data should be collected on, but not limited to, the distribution, density, growth, mortality, and production of each stage within all habitats occupied, or formerly occupied, by the species. These data should be obtained from the best available information, including peer-reviewed literature, data reports and "gray" literature, data files of government resource agencies, and any other sources of quality information.

The following approach should be used to gather and organize the data necessary for identifying EFH. Information from all levels should be used to identify EFH. The goal of this procedure is to include as many levels of analysis as possible within the constraints of the available data. Councils should strive to obtain data sufficient to describe habitat at the highest level of detail (i.e., Level 4).

> Level 1: Presence/absence distribution data are available for some or all portions of the geographic range of the species. At this level, only presence/absence data are available to describe the distribution of a species (or life history stage) in relation to potential habitats. Care should be taken to ensure that all potential habitats have been sampled adequately. In the event that distribution data are available for only portions of the geographic area occupied by a particular life history stage of a species, EFH can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior.
>
> Level 2: Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life history stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.
>
> Level 3: Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life history stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).
>
> Level 4: Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

The information obtained through the analysis of this section will allow Councils to assess the relative value of habitats. Councils should interpret this information in a risk-averse fashion, to ensure adequate areas are protected as EFH of managed species. Level 1 information, if available, should be used to identify the geographic range of the species. Level 2 through 4 information, if available, should be used to identify the

habitats valued most highly within the geographic range of the species. If only Level 1 information is available, presence/absence data should be evaluated (e.g., using a frequency of occurrence or other appropriate analysis) to identify those habitat areas most commonly used by the species. Areas so identified should be considered essential for the species. However, habitats of intermediate and low value may also be essential, depending on the health of the fish population and the ecosystem. Councils must demonstrate that the best scientific information available was used in the identification of EFH, consistent with national standard 2, but other data may also be used for the identification. If a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible. Once the fishery is no longer considered overfished, the EFH identification should be reviewed, and the FMP amended, if appropriate. EFH will always be greater than or equal to aquatic areas that have been identified as "critical habitat" for any managed species listed as threatened or endangered under the Endangered Species Act. Where a stock of a species is considered to be healthy, then EFH for the species should be a subset of all existing habitat for the species.

Ecological relationships among species and between the species and their habitat require, where possible, that an ecosystem approach be used in determining the EFH of a managed species or species assemblage. The extent of the EFH should be based on the judgment of the Secretary and the appropriate Council(s) regarding the quantity and quality of habitat that is necessary to maintain a sustainable fishery and the managed species' contribution to a healthy ecosystem. If degraded or inaccessible aquatic habitat has contributed to the reduced yields of a species or assemblage, and in the judgment of the Secretary and the appropriate Council(s), the degraded conditions can be reversed through such actions as improved fish passage techniques (for fish blockages), improved water quality or quantity measures (removal of contaminants or increasing flows), and similar measures that are technologically and economically feasible, then EFH should include those habitats that would be essential to the species to obtain increased yields.

The general distribution and geographic limits of EFH for each life history stage should be presented in FMPs in the form of maps. Ultimately, these data should be incorporated into a geographic information system (GIS) to facilitate analysis and presentation. These maps may be presented as fixed in time and space, but they should encompass all appropriate temporal and spatial variability in the distribution of EFH. If the geographic boundaries of EFH change seasonally, annually, or decadally, these changing distributions need to be represented in the maps. Different types of EFH should be identified on maps along with areas used by different life history stages of the species. The type of information used to identify EFH should be included in map legends, and more detailed and informative maps should be produced as more complete information about population responses (e.g., growth, survival, or reproductive rates) to habitat characteristics becomes available. Where the present distribution or stock size of a species or life history stage is different from the historical distribution or stock size, then maps of historical habitat boundaries should be included in the FMP, if known. The EFH maps are a means to visually present the EFH described in the FMP. If the maps identifying EFH and the information in the description of EFH differ, the description is ultimately determinative of the limits of EFH.

Prey species

Loss of prey is an adverse effect on EFH and a managed species, because one component of EFH is that it be necessary for feeding. Therefore, actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species may be considered adverse effects on a managed species and its EFH. FMPs should identify the major prey species for the species in the FMU and generally describe the location of prey species' habitat. Actions that cause a reduction of the prey species population,

including where there exists evidence that adverse effects to habitat of prey species is causing a decline in the availability of the prey species, should also be described and identified. Adverse effects on prey species and their habitats may result from fishing and non-fishing activities.

Identification of habitat areas of particular concern

FMPs should identify habitat areas of particular concern within EFH. In determining whether a type, or area of EFH is a habitat area of particular concern, one or more of the following criteria must be met:

(i) The importance of the ecological function provided by the habitat.
(ii) The extent to which the habitat is sensitive to human-induced environmental degradation.
(iii) Whether, and to what extent, development activities are, or will be, stressing the habitat type.
(iv) The rarity of the habitat type.

SUMMARY OF CRAB TECHNICAL TEAM APPROACH AND COMMENTS

Summaries and assessments of habitat information for the Bering Sea and Aleutian Islands (BSAI) crab species are provided in Essential Fish Habitat Assessment Report (NPFMC *In prep*.). The crab technical team reviewed habitat descriptions and life history information to determine the levels of information available for each life stage of king and Tanner crabs in the Fishery Management Plan for BSAI. The North Pacific Fishery Management Council Crab Plan Team assisted in this review.

Stocks of BSAI crabs have widely varying levels of information available. Some stocks have only limited fishery data while Bristol Bay red king and Tanner crabs have been studied intensely. In reviewing the array of information, the technical team defined five life history stages for crab based on their habitat requirements and five information levels to describe EHF. The team noted that the type and level of information available for most BSAI crabs' life stage was minimal compared to the expectations of the national guidelines for description and identification of EFH.

Life history stages of king and Tanner crabs were defined according to accepted habitat usage: eggs, larvae, early juveniles, late juveniles, and mature crabs (Tyler and Kruse 1996, 1997; Epifanio 1988).

Egg Stage

Female king and Tanner crab extrude eggs, carry and nurture them outside the maternal body. The number of eggs developed by the female increases with body size and is linked to nutrition at favorable temperatures. Information on egg bearing females is used to define habitat for the egg stage of crabs.

Larval Stage

Successful hatch of king and Tanner crab larvae is a function of temperature and concentration of diatoms so presence of larvae in the water column can vary accordingly. Larvae are planktonic. They are minute forms and their sustained horizontal swimming is inconsequential compared to horizontal advection by oceanographic conditions. Larvae vertically migrate within the water column to feed. Diel vertical migration may be a retention mechanism to transport larvae inshore.

Early Juvenile Stage

The early juvenile stage includes crabs first settling on the bottom (glacothoe and megalops), young of the year crabs, and crabs up to a size approximating age 2. Habitat relief is obligatory for red and blue King crabs of this life stage. Individuals are typically less than 20 mm CL distributed in nearshore waters among niches provided by sea star arms, anemones, shell hash, rocks and other bottom relief. Early juvenile Tanner crab settle on mud, are known to occur there during summer but are not easily found in this habitat in winter.

Late Juvenile Stage

The late juvenile stage for crab is defined as the size at about age 2 to the first size of functional maturity. Late juvenile crabs are typically found further offshore in cooler water than early juvenile crabs. Smaller red king crabs of this life stage form pods during day that break apart during the night when the crabs forage and molt. As these crabs increase in size, podding behavior declines and the animals are found to forage throughout the day.

Mature Stage

Mature crabs are defined as those crabs of a size that is functionally mature. Functional maturity is based on size observed in mating pairs of crabs. This maturity definition differs from morphometric maturity based on chela height and physiological maturity when sperm or eggs can be produced. The mature stage includes crabs from the first size of functional maturity to senescence.

The type of habitat information available for almost all crab species is spatial distribution over depth and broad geographic areas as collected from survey and fishery samples that have limited linkage with habitat characteristics. Coupled with traditional knowledge these data demonstrate that geographic distribution of crab contracts and expands due to a variety of factors including, but not limited to, temperature changes, current patterns, changes in population size, and changes in predator and prey distribution. The distributions of many crab species' life stages are based on historical data and information about the entire geographic range is included in the text description of each species. The technical team agreed that maps should delineate where possible the EFH distributions and known areas of high crab concentrations within United States (3-200 nautical miles) and State of Alaska (0-3 miles) waters.

Specific data are lacking to precisely define localized habitat for each life stage of crab because surveys are cost prohibitive to document the expanse of king and Tanner crab habitat along the coast line of the Bering Sea and Aleutian Islands and on the continental shelf and slope. Consequently, the oceanographic (temperature, salinity, nutrient, current), trophic (presence/absence of food and predators), and physical (depth, substrate, latitude, and longitude) characteristics of crab habitat are restricted for most crab species and life stages to broad general associations. Types of data used to describe habitat association of BSAI king and Tanner crabs include: AFSC trawl surveys; the OCSEAP survey, NMFS and ADF&G tagging surveys, ADF&G pot surveys; ADF&G shellfish observer program; ADF&G harvest records, and Japanese and Russian surveys.

A primary source of many of the maps featured in this document was the NOS publication, Coastal and Ocean Zones Strategic Assessment: Data Atlases of the West Coast of North America and the Bering, Chukchi and Beaufort Seas (1988, 1990). These maps provide the reasonable coverage of the distributions of larger crabs. However, the source data depends on the catchability of female crabs and late juvenile crabs in survey gear only irregular surveys target larval and early juvenile life stages. Additionally, inaccuracies might exist in extending mapped distributions based on habitat associations. The distributions shown in this preliminary report are first-cut and should be verified and updated as better or more current data become available.

The following information classification scheme was adopted for BSAI crabs.

Level 0
No systematic sampling has been conducted for this species and life stage; may have been caught opportunistically in small numbers during other research surveys.

Level 1
Presence/absence distribution data are available for some or all portions of the geographic range.

Level 2
Habitat-related densities are available. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value.

Level 3
Habitat-related growth, reproduction, or survival rates are available. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).

Level 4
Habitat-related production rates are available. Essential habitats are necessary to maintain fish production consistent with a sustainable fishery and a healthy ecosystem.

Information levels used in describe EFH for crab species were based on the best scientific data available. The crab technical team adopted the groundfish technical team's classification scheme that includes an additional level of information, level 0. Level 0 is considered a subset of the information level 1definition in the proposed guidelines. The crab technical team noted that for BSAI crabs, the minimum level of habitat information has been gathered by systematic sampling therefore opportunistic samples of crab have not been included in the assessment of crab EFH. Level 0 denotes absence of systematic sampling data for a species and life stage. Level 1 information is presence/absence of systematic sampling data for a species and life stage and encompasses the area of general distribution for some or all portions of its' geographic range. Level 2 information is density of a crab species' life stage by depth, geographic area and inferred habitat. Information level 2 includes the definition for level 1 and additional data that refines definition of habitat occupied by a species' life stage.

The crab technical team agreed with the groundfish technical team's recommendations on how information levels could be applied to defining EFH. In cases where a level 0 has been assigned, no data exist and no comment on EFH has been offered. The crab technical team recommends that EFH be defined as everywhere the species' life stage has been documented through systematic sampling, plus all areas of similar habitat based on NOS charts, the literature, and the opinions of scientists and persons with local knowledge. This EFH recommendation would apply to a species' life stage with level 1 and greater information.

Levels of essential fish habitat information currently available for BSAI crab stocks, by life history stage.

Species/Stock	Eggs	Larvae	Early Juveniles[1]	Late Juveniles[2]	Adults
Red King Crab					
Bristol Bay	2	2	1	2	2
Pribilof Islands	2	1	0c	2	2
Norton Sound	2	0c	0c	2	2
Dutch Harbor	2	0c	0c	2	2
Adak	1	0c	0c	0c	1
Blue King Crab					
Pribilof Islands	2	1	2	2	2
St. Matthew I.	1	0c	0c	1	2
St. Lawrence I.	0b	0c	0c	0c	1
Golden King Crab					
Seaguam Pass	2	0c	0c	2	2
Adak	1	0c	0c	1	2
Pribilof Islands	1	0c	0c	1	2
Northern District	0c	0c	0c	0c	0c
Scarlet King Crab					
Bering Sea	0b	0c	0c	0c	1
Adak	0b	0c	0c	0c	1
Dutch Harbor	0b	0c	0c	0c	1
Tanner Crab (C. bairdi)					
Bristol Bay	2	1	1	2	2
Pribilof Islands	2	1	1	2	2
Eastern Aleutians	1	0c	1	2	2
Western Aleutians	0b	0c	0c	0c	1
Snow Crab (C. Opilio)					
Eastern Bering Sea	2	1	1	2	2
Grooved Crab (C. tanneri)					
Bering Sea	0b	0c	0c	0c	1
Eastern Aleutians	0b	0c	0c	0c	1
Western Aleutians	0b	0c	0c	0c	1

Species/Stock	Eggs	Larvae	Early Juveniles[1]	Late Juveniles[2]	Adults
Triangle Crab (C. angulatus)					
Bristol Bay	1	0c	0c	0c	1
Eastern Aleutians	1	0c	0c	0c	1

[1] Early juvenile crab are defined as settled crab up to a size approximating age 2.
[2] Late juvenile crab are defined as age 2 through the first size of functional maturity.
Note: For any crab species/stock's life stage at level 0, information was insufficient to infer general distribution (0a).
0b: No information on the life stage, but some information on a similar species or adjacent life stage from which to infer general distribution.
0c: No information on the actual species' life stage and no information on a similar species or adjacent life stages, or where complexity of a species stock structure prohibited inference of general distribution.

The crab technical team did note distinguishing characteristics of crab habitat "necessary for spawning, breeding, feeding and growth to maturity" based on the best available scientific data and collective scientific opinion. Habitat can be partitioned according to depth both between crab species and among different life history stages of a given species.

Shallow inshore areas (less than 50 m depth) are very important to king crab reproduction as they move onshore to molt and mate. Tanner crabs also occupy shallower depths during molting and mating. All BSAI crab are highly vulnerable to predation and damage during molting when they shed their exoskeleton. King crab usually molt annually to mate while Tanner and snow crab exhibit terminal molt and carry sperm for future clutch fertilization. The habitat occupied by molting and mating crab differs from that occupied by mature crabs during the remainder of the year. The crab technical team noted protection of crab in molting mating habitat during this sensitive life history stage is important.

Larval stages are distributed according to vertical swimming abilities, and the currents, mixing, or stratification of the water column. Generally, the larval stages occupy the upper 30 m, often in the mixed layer near the sea surface. As the larvae molt and grow into more actively swimming stages they are able to seek a preferred depth. After molting through multiple larval stages, crabs settle on the bottom. Settlement on habitat with adequate shelter, food, and temperature is imperative to survival of first settling crabs. Young of the year red and blue king crabs require nearshore shallow habitat with significant cover that offers protection (e.g., sea stars, anemones, macroalgae, shell hash, cobble, shale) to this frequently molting life stage. Early juvenile stage Tanner and snow crab also occupy shallow waters and are found on mud habitat. Late Juvenile stage crabs are most active at night when they feed and molt. The crab technical team emphasized the importance of shallow areas to all early juvenile stage crabs and in particular the importance to red and blue king crabs of high relief habitat nearshore with extensive biogenic assemblages. The area north and adjacent to the Alaska peninsula (Unimak Island to Port Moller), the eastern portion of Bristol Bay, and nearshore areas of the Pribilof and Saint Matthew Islands are locations known to be particularly important for king crab spawning and juvenile rearing.

Each life stage for stocks of BSAI crabs is concentrated at some combination of depth, habitat, geographic area, or time of year. Areas of known concentration of some species' life stages can be identified within the reported general distribution of several BSAI crab stocks. However, information to delineate areas of known concentration for each life stage is not available for many of the BSAI crabs. The crab technical team recommends EFH be designated as the general distribution of a species' life stage. The reasons for selecting the general distribution even when known concentrations can be delineated include: 1) temporal variation in location of crab life stages within habitat; 2) resolution of habitat descriptions differs from known distributions of a crab species' life stage relative to habitat;3) concentrations of mature crabs contracts and expands with decline and rise of population abundance likely changing the boundaries of known concentration; and 4) geographic areas with high concentration of a species' life stage are encompassed in the general distribution.

All crab species' life stages in the BSAI rely on habitat associated prey. From settling larvae to senescence, crabs dwell on the bottom and are dependent on benthic feeding. The importance of habitat quality to crab diet seems intuitive but is not quantified for benthic life stages. The team recognized change in diet due to habitat disturbance and alteration will impact crab survival and potentially long term production.

Life History Traits for BSAI King and Tanner Crab Species

			Feeding Types					Movements							Behavior								Periods				
Species	Life Stage\Activity	Duration of Life Stage (years)	Lecithotrophic	Planktotrophic	Omnivore	Detritivore	Unknown	Drift with Ocean Conditions	Reside in Nursery Areas	Inshore Molting\Mating Migration	Offshore Migration	Diel Migration	Noctunally Active	Unknown	Solitary	Burroughing	Mating Aggregation	Molting Aggregation	Defensive\Podding Aggregation	Spacial Aggregation	Other Aggreagtion	Unknown	Months Molting	Unknown	Months Mating	Unknown	Life Stage\Activity
Red King Crab	M	7-15+			●					●	●		●		●		●		fem	●			Dec-Jun		Jan-Jul		M
	LJ	4			●						●		●						●	●			Year Around				LJ
	EJ	2			●				●				●		●					●			Year Around				EJ
	L	0.2		●				●				●										●	Mar-Jul				L
	E	1	●																								E
Blue King Crab	M	8+			●					●	●		●		●		●			●			Jan-Jul		Jan-Jul		M
	LJ	4			●						●		●		●					●			Year Around				LJ
	EJ	2		●	●				●				●		●					●			Year Around				EJ
	L	0.2						●				●			●								Mar-Jun				L
	E	1-1.5	●																								E
Golden King Crab	M	6+			●									●						●			Year Around		Year Around		M
	LJ	4-5			●									●						●			Year Around				LJ
	EJ	2			●				●													●	Year Around				EJ
	L	0.2	●											●								●	Year Around				L
	E	1	●											●													E
Scarlet King Crab	M				●									●								●					M
	LJ				●									●								●					LJ
	EJ				●				●													●					EJ
	L		●											●								●					L
	E		●											●													E
Tanner Crab	M	6				●				●	●				●	●	●			●			Jan-Jun		Feb-Jun		M
	LJ	4				●					●				●	●							Jan-Dec				LJ
	EJ	2				●			●						●	●							Jan-Dec				EJ
	L	0.2		●				●				●								●			Jun-Jul				L
	E	1	●																								E
Snow Crab	M	6			●					●	●				●	●				●			Jun-Jul		Jun-Jul		M
	LJ	4			●						●				●	●							Year Around				LJ
	EJ	2			●				●						●	●							Year Around				EJ
	L	0.2		●				●				●								●			Jun-Jul				L
	E	1	●																								E
Grooved Tanner Crab	M						●							●								●		●		●	M
	LJ						●							●								●		●		●	LJ
	EJ						●							●								●		●		●	EJ
	L						●							●								●		●		●	L
	E						●							●								●		●		●	E
Traingle Tanner Crab	M						●							●								●		●		●	M
	LJ						●							●								●		●		●	LJ
	EJ						●							●								●		●		●	EJ
	L						●							●								●		●		●	L
	E						●							●								●		●		●	E

Habitat Associations for BSAI King and Tanner Crab Species

		Pelagic Domain										Benthic Domain										Structure																Substrate										Community											Ocean		
												Shelf					Slope			Canyon																																										
Species	Life Stage\Activity	Estuarine	Inshore Water (0-3 miles)	Offshore Water (3+ miles)	Surface Water	Midwater	Near Bottom	Vertical Depth (m)	Epipelagic (<200m)	Mesopelagic (200-1000m)	Bathypelagic (>1000m)	Bottom Depth Range (m)	Intertidal	Subtidal (<30m)	Middle (30-100m)	Outer (100-200m)	Upper (Break-500m)	Intermediate (500-1000m)	Lower (>500m)	Head (<100m)	Upper and Middle (100-500m)	Lower (>500m)	Bars	Banks	Sinks	Slumps\Rockfalls\Debris Field	Channels	Ledges	Pinnacles	Reefs	Vertical Walls	Man-made	Organic Debris	Mud\Clay\Silt	Sand\Granule	Gravel	Pebble	Cobble	Boulder	Bedrock	Algal Cover	Anenomes	Enchinoderms	Corals (soft)	Mollusca	Drift Algae\Kelp	Kelp Forest	Polychaetes	Sea Grasses	Sea Onions	Tunicates	Temperature (Celsius)	Salinity (ppt)	Life Stage\Activity
Red King Crab	M											3-300		●	●	●	●						●	●	●	●	●	●		●			●	●	●	●					●	●	●	●	●	●	●		●	●	<6°	>25	M
	LJ											0-200	●	●	●		●						●	●	●	●	●	●		●			●	●	●	●				●		●	●	●	●	●	●		●	●			LJ
	EJ											0-50	●	●	●	●	●																																							>20	EJ
	L	●	●	●	●	●	●					0-100																																								<12	>20	L
	E											0-200	●	●	●	●	●						●	●	●	●	●	●		●			●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<6	>25	E
Blue King Crab	M											0-200		●	●	●							●	●	●	●	●	●	●	●	●		●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<6	>25	M
	LJ											0-200		●	●	●							●	●	●	●	●	●	●	●	●		●	●	●	●	●	●				●	●	●	●	●	●	●		●	●			LJ
	EJ											<50	●	●	●								●	●	●	●	●	●	●	●	●		●	●	●	●	●	●				●	●	●	●	●	●	●		●	●			EJ
	L	●	●	●	●	●	●		●			0-100																																										L
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Golden King Crab	M											100-1000				●	●	●	●		●	●		●		●	●	●	●	●	●				●	●	●	●	●				●	●	●	●			●				<5	>30	M
	LJ											>1000							●		●	●		●		●	●	●	●	●	●				●	●	●	●	●				●	●	●	●			●				<5	>30	LJ
	EJ											>1000							●			●																															<5	>30	EJ
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	E											100-1000				●	●	●	●		●	●		●		●	●	●	●	●	●				●	●	●	●	●	●			●	●	●	●			●				<5	>30	E
Scarlet King Crab	M											300+					●	●	●		●	●																																<4	>33	M
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Tanner Crab	M											3-700		●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	M
	LJ											3-200		●	●	●				●	●		●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	LJ
	EJ											3-200		●	●	●				●	●		●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	EJ
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	E											3-700		●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	E
Snow Crab	M											25-400		●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	M
	LJ											25-200		●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	LJ
	EJ											25-150		●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●				●	●	●	●	●	●	●		●	●	<10	>30	EJ
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Grooved Tanner Crab	M											200-1000				●	●	●			●	●																																		M
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Habitat Description for Red king crab
Paralithodes camtschaticus

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Red king crab (*Paralithodes camtshaticus*) is widely distributed throughout the Bering Sea and Aleutian Islands, Gulf of Alaska, Sea of Okhotsk, and along the Kamchatka shelf. Red king crab are typically at depths < 100 fm. King crab molt multiple times per year through age 3 after which molting is annual. At larger sizes, king crab may skip molt as growth slows. Females grow slower and do not get as large as males. In Bristol Bay, fifty percent maturity is attained by males at 12 cm carapace length and 9 cm carapace length by females (about 7 years). Female red king crab in the Norton Sound area reach 50% maturity at 6.8 cm and do not attain maximum sizes found in other areas. Size at 50% maturity for females in the Western Aleutians is 8.9 cm carapace length. Natural mortality of adult red king crab is estimated at about 25 percent per year (M=0.3), due to old age, disease, and predation.

Fishery

The red king crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 foot square) set on single lines. Mean age at recruitment is 8-9 years. Two discrete populations of red king crab are actively fished in the BSAI region: Bristol Bay and Norton Sound. A third population surrounding the Aleutian Islands was managed separately as Adak and Dutch Harbor stocks until 1996 when the management areas were combined. The fishery on the Adak stock was closed in 1996 and the fishery on the Dutch Harbor stock has closed since the 1983-84 season. These fisheries historically occurred in the winter-spring. Red king crab are allowed as bycatch during golden king crab fisheries in the area. Other populations of red king crab are fished in the Pribilof Islands area, St. Matthew, and St. Lawrence Island area, but are managed in conjunction with the predominant blue king crab fisheries. Red king crab stocks are managed separately to accommodate different life histories and fishery characteristics. Male only red king crab >16.5 cm carapace width are allowed to be taken from Bristol Bay and the Pribilof and Aleutian Islands. The minimum size limit for harvest of male only crab from the Norton Sound and the St. Matthew and St. Lawrence Island population is 12 cm. The season in Bristol Bay begins on November 1, and generally has lasted less than 10 days in recent years. Bycatch in red king crab fisheries is comprised primarily of Tanner crab and nonlegal red king crab. The commercial fishery for red king crab in Norton Sound occurs in the summer, opening July 1 and a winter through the ice fishery opens November 15 and closes May 15.

Relevant Trophic Information

Pacific cod is the main predator on red king crabs. Walleye pollock, yellowfin sole, and Pacific halibut are minor consumers of pelagic larvae, settling larvae, and larger crabs, respectively. Juvenile crab are cannibalistic during molting.

Describe any potential gear impacts on the habitats of this or other species

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

What is the approximate upper size limit of juvenile fish (in cm)?

The size of 50 percent maturity is 7 and 9 cm carapace length for female and male red king crabs from Norton Sound and St. Matthew and St. Lawrence Islands; 9 and 12 cm for Bristol Bay and Pribilof and Aleutian Islands.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Larry Boyle, (907)-581-1239
ADF&G, Dutch Harbor, AK, Rance Morrison, Robert Gish (907)-581-1239

Habitat and Biological Associations Narrative

Egg
Level 1 & 2. See mature. Egg hatch of larvae is synchronized with the spring phytoplankton bloom in Southeast Alaska suggesting temporal sensitivity in the transition from benthic to planktonic habitat. Essential habitat of the red king crab egg stage is based on the general distribution (level 1) and habitat related density (level 2) of egg bearing red king crabs of the Bristol Bay, Pribilof Islands, Norton Sound and Dutch Harbor stocks. General distribution (level 1) of egg bearing female red king crab is used to identify essential habitat for the Adak stock.

Larvae
Level 1 & 2. Red king crab larvae spend 2-3 months in pelagic larval stages before settling to the benthic life stage. Reverse diel migration and feeding patterns of larvae coincide with the distribution of food sources. Essential habitat is identified for larvae of the Bristol Bay red king crab stock using the general distribution (level 1) and density (level 2) of larvae in the water column. Essential habitat is defined for larvae of the Pribilof Islands stock based on knowledge of the general distribution (level 1) of larvae in the water column. No essential habitat is defined for larvae of red king crab stocks in Norton Sound, Dutch Harbor and Adak waters.

Early Juvenile
Level 1. Early juvenile stage red king crabs are solitary and need high relief habitat or coarse substrate such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians. Young-of-the-year crabs occur at depths of 50 m or less. Essential habitat for early juveniles is defined for Bristol Bay red king crabs as the general distribution (level 1). No essential fish habitat is defined for red king crab early juveniles in Pribilof Islands, Norton Sound, Dutch Harbor and Adak stocks.

Late Juvenile
Level 2. Late juvenile stage red king crabs of the ages of two and four years exhibit decreasing reliance on habitat and a tendency for the crab to form pods consisting of thousands of crabs. Podding generally continues until four years of age (about 6.5 cm), when the crab move to deeper water and join adults in the spring migration to shallow water for molting and mating. Essential habitat based on general distribution (level 1) and density (level 2) of late juvenile red king crabs is known for Bristol Bay, Pribilof Islands, Norton Sound and Dutch Harbor stocks. Essential habitat is not defined for late juvenile red king crabs in the Adak stock.

Mature
Level 1 & 2. Mature red king crabs exhibit seasonal migration to shallow waters for reproduction. The remainder of the year red king crabs are found in deep waters. In Bristol Bay, red king crabs mate when they enter shallower waters (<50 m), generally beginning in January and continuing through June. Males grasp females just prior to female molting, after which the eggs (43,000 to 500,000 eggs) are fertilized and extruded on the female's abdomen. The female red king crab carries the eggs for 11 months before they hatch, generally in April. Essential habitat for mature red king crabs is known for Bristol Bay, Pribilof

Islands, Norton Sound and Dutch Harbor stocks based on general distribution (level 1) and density (level 2). Essential habitat for mature red king crabs in Adak is known from general distribution data (level 1).

SPECIES: Red king crab, *Paralithodes camtschaticus*

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs 1	11 mo	NA	May-April	NA	NA	NA	F	
Larvae 1	5 mo	Diatoms, Phytoplankton Copepod nauplii	April-August	MCS, JCS	P	NA	F	
Juveniles 1	1 to 5-6 yrs	Diatoms Hydroids	All year	ICS, MCS, BCH, BAY	D	SAV (epifauna), R, CB, G	F	Found among biogenic assemblages (sea onions, tube worms, bryozoans, ascidians)
Adults 1	5-6+ yrs	Mollusks, echinoderms, polychaetes, decapod, crustaceans, Algae, urchins, hydroids, sea stars	Spawning Feb- June	MCS, ICS, BAY, BCH	D	S, M, CB, G	F	

See table of contents for the following maps:

Red king crab eggs

Red king crab larvae

Red king crab early juveniles

Red king crab late juveniles

Red king crab spawners

Red king crab matures

Habitat Description for Blue king crab
Paralithodes platypus

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Blue king crab (*Paralithodes platypus*) has a discontinuous distribution throughout their range (Hokkaido, Japan to Southeast Alaska). In the Bering Sea, discrete populations exist in the cooler waters around the Pribilof Islands, St. Matthew Island, and St. Lawrence Island. Smaller populations have been found in Herendeen Bay, and around Nunivak and King Island, as well as isolated populations in the Gulf of Alaska. Blue king crab molt multiple times as juveniles. In the Pribilof area, 50 percent maturity of females is attained at 9.6 cm carapace length, which occurs at about 5 years of age. Blue king crab in the St. Matthew area mature at smaller sizes (50 percent maturity at 8.1 cm carapace length for females) and do not get as large overall. Skip molting occurs with increasing probability for those males larger than 10 cm carapace length and is more prevalent for St. Matthew Island crab. Larger female blue king crab have a biennial ovarian cycle and a 14 month embryonic period. Unlike red king crab, juvenile blue king crab do not form pods, instead relying on cryptic coloration for protection from predators. Adult male blue king crab occur at an average depth of 70 m and an average temperature of 0.6 degrees C.

Fishery

The blue king crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 foot square) set on single lines. Two discrete stocks of blue king crab are fished: the Pribilof Islands and St. Matthew Island stocks. These blue king crab fisheries have occurred in September in recent years. Bycatch in the blue king crab fisheries consist almost entirely of non-legal blue king crabs. Male only crabs >16.5 cm carapace width are harvested in the Pribilof Islands while the St. Matthew Islands fishery is managed with a minimum size limit of 140 mm.

Relevant Trophic Information

Pacific cod is a predator on blue king crabs.

Describe any potential gear impacts on the habitats of this or other species

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

What is the approximate upper size limit of juvenile fish (in cm)?

The size of 50 percent maturity is 9 and 12 cm carapace length for female and male crabs from the Pribilof Islands, and 8 and 10.5 cm for St. Matthew Island.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Larry Boyle, 907-581-1239
ADF&G, Dutch Harbor, AK, Rance Morrison, 907-581-1239

Habitat and Biological Associations Narrative

Egg

Level 1 & 2. See Mature. Essential habitat for eggs is known for the stock of blue king crab in the Pribilof Islands based on general distribution (level 1) and density (level 2) of egg bearing female crabs. Essential habitat for eggs of the St. Matthew Island blue king crab stock is based on general distribution (level 1) of the egg bearing females. Essential habitat for eggs is unknown for the St. Lawrence Island blue king crab stock.

Larvae

Level 1. Blue king crab larvae spend 3.5 to 4 months in pelagic larval stages before settling to the benthic life stage. Larvae are found in waters of depths between 40 to 60 m. Essential habitat of larval blue king crab of the Pribilof Islands stock is defined using the general distribution (level 1) of larvae in the water column. Information to define essential habitat is not available for the St. Matthew Island and St. Lawrence Island stocks of larval blue king crab.

Early Juvenile

Level 2. Early juvenile blue king crabs require refuge substrate characterized by gravel and cobble overlaid with shell hash, and sponge, hydroid and barnacle assemblages. These habitat areas have been found at 40-60 m around the Pribilof Islands. Essential habitat of early juvenile blue king crabs is based on general distribution (level 1) and density (level 2) of this life stage in the Pribilof Island stock. Information to define essential habitat for early juvenile blue king crabs in the St. Matthew Island and St. Lawrence Island stocks is not available.

Late Juvenile

Level 1 & 2. Late juvenile blue king crab require nearshore rocky habitat with shell hash. Essential habitat is based on general distribution (level 1) and density (level 2) of late juvenile blue king crab of the Priblilof Islands stock. General distribution (level 1) of the late juvenile blue king crabs is used to identify essential habitat for the St. Matthew Island stock. Information is not available to define essential habitat for the St. Lawrence Island stock of late juvenile blue king crab.

Mature

Level 1 & 2. Mature blue king crabs occur most often between 45-75 m depth on mud-sand substrate adjacent to gravel rocky bottom. Female crabs are found in a habitat with a high percentage of shell hash. Mating occurs in mid-spring. Larger older females reproduce biennially while small females tend to reproduce annually. Fecundity of females range from 50,000-200,000 eggs per female. It has been suggested that spawning may depend on availability of nearshore rocky-cobble substrate for protection of females. Larger older crabs disperse farther offshore and are thought to migrate inshore for molting and mating. General distribution (level 1) and density (level 2) of mature blue king crab are used to identify essential habitat for the Pribilof Islands and St. Matthew Island stocks. Essential habitat of mature blue king crab is based on distribution (level 1) data for the St. Lawrence Island stock.

SPECIES: Blue king crab, *Paralithodes platypus*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs 1	14 mo.	NA	Starting April-May	NA	NA	NA	F	
Larvae 1	3.5 to 4 mo.		April-July	MCS, ICS	P	NA	F	
Juveniles 1			All year	MCS, ICS	D	CB, G, R	F	
Adults 1			Spawning Feb-Jun	MCS, ICS	D	S, M, CB, G, R	F	

See table of contents for the following maps:

Blue king crab eggs

Blue king crab larvae

Blue king crab early juveniles

Blue king crab late juveniles and matures

Habitat Description for Golden king crab
Lithodes aequispina

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Golden king crab (*Lithodes aequispina*), also called brown king crab, range from Japan to British Columbia. In the Bering Sea and Aleutian Islands, golden king crab are found at depths from 100 m to 1,000 m, generally in high relief habitat such as inter-island passes, and are usually slope-dwelling. Size at sexual maturity depends on latitude ranging from 9.8 - 11 cm carapace length, with crabs in the northern areas maturing at smaller sizes. Females carry up to 20,000 eggs, depending on female size. The season of reproduction appears to be protracted, and perhaps year-round.

Fishery

The golden king crab fisheries are prosecuted using mesh covered pots set on longlines to minimize gear loss. The primary fishery is in the Aleutian Islands, with minor catches coming from localized areas in the Bering Sea and Gulf of Alaska. Until 1996, the golden king crabs in the Aleutian Islands were managed as two separate stocks: Adak and Dutch Harbor. The fishing season opens September 1 and male crab >15.2 cm are harvested. Golden king crab are harvested in the Bering Sea under conditions of a permit issued by the Commissioner of Fish and Game. Bycatch consists almost exclusively of non-legal golden king crab. Escape rings were adopted by the Board in 1996 to reduce capture and handling mortality of non-target crab; a minimum of four 5.5" rings are required on pots used in golden king crab fisheries.

Relevant Trophic Information

Describe any potential gear impacts on the habitats of this or other species

What is the approximate upper size limit of juvenile fish (in cm)?

The size (carapace length) at 50% maturity for females and males: Aleutians 11 and 12.5 cm, Pribilofs 10 and 10.7 cm, Northern Bering Sea 9.8 and 9.2 cm.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Larry Boyle, 907-581-1239
ADF&G, Dutch Harbor, AK, Robert Gish, 907-581-1239

Habitat and Biological Associations Narrative

Golden king crabs occur on hard bottom, over steep rocky slopes and on narrow ledges. Strong currents are prevalent. Golden king crabs coexist with abundant quantities of epifauna; sponges, hydroids, coral, sea stars, bryozoans, and brittle stars.

Egg

Level 0, 1 & 2. See mature. General distribution (level 1) and density (level 2) of egg bearing female golden king crabs is used to identify essential habitat for the Sequam Pass stock. Essential habitat for the egg life

stage of the Adak and Priblilof Islands stocks is based on general distribution (level 1) of the egg bearing female crabs.

Larvae

Level 0. Information to define essential habitat of golden king crab larvae is not available for the Seguam Pass, Adak, Pribilof Islands or Northern District stocks.

Early Juvenile

Level 0. Information to define essential habitat of early juvenile golden king crabs is not available for the Seguam Pass, Adak, Pribilof Islands or Northern District stocks.

Late Juvenile

Level 0, 1, & 2. Late juvenile golden king crabs are found throughout the depth range of the species. Abundance of late juvenile crab increases with depth and these crab are most abundant at depths >548 m. Essential habitat for late juvenile golden king crabs is based on general distribution (level 1) and density (level 2) of this life stage for the Sequam Pass stock. General distribution (level 1) of late juvenile golden king crabs is used to identify essential habitat for the Adak and Pribilof Islands stock. Information to define essential habitat is not available for late juvenile golden king crabs of the Northern District stock.

Mature

Level 0 & 2. Mature golden king crabs occur at all depths within their distribution. Males tend to congregate in somewhat shallower waters than females, and this segregation appears to be maintained throughout the year. Legal male crabs are most abundant between 274 m and 639 m. Abundance of sub-legal males increases at depth >364 m. Female abundance is greatest at intermediate depths between 274 m and 364 m. General distribution (level 1) and density (level 2) of mature golden king crabs are used to identify essential habitat for the Sequam Pass, Adak and Pribilof Islands stocks. Information is not available to define essential habitat for mature golden king crabs of the Northern district stock.

SPECIES: Golden king crab, *Lithodes aequispina*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs 0								
Larvae 0								
Juveniles 0								
Adults 0		Ophiuroids, sponges, plants	Spawning Feb.-Aug.					

See table of contents for the following maps:

Golden king crab eggs

Golden king crab late juveniles and matures

Habitat Description for Scarlet king crab
Lithodes couesi

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Little information is available on the biology of the scarlet king crab (*Lithodes couesi*), found in the Bering Sea and Aleutian Islands area. Based on data from the Gulf of Alaska, this species occurs in deep water, primarily on the continental slope. Spawning may be asynchronous. Females can produce up to 5,000 eggs, depending
on female size.

Fishery

Scarlet king crab are harvested by longlining mesh covered pots. Directed fishing may occur only under conditions of a permit issued by the commissioner of Fish and Game. Scarlet king crab also taken incidentally in the golden king crab fishery.

Relevant Trophic Information

Describe any potential gear impacts on the habitats of this or other species

What is the approximate upper size limit of juvenile fish (in cm)?

The size (carapace length) of 50% maturity for female and males is 8 cm and 9.1 cm.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Larry Boyle, 907-581-1239
ADF&G, Dutch Harbor, AK, Robert Gish, 907-581-1239

Habitat and Biological Associations Narrative

Scarlet king crab are associated with steep rocky outcrops and narrow ledges. Strong currents are prevalent.

Egg
Level 0. Information to define essential habitat for scarlet king crab eggs is not available for the Bering Sea, Adak or Dutch Harbor stocks.

Larvae
Level 0. Information to define essential habitat for scarlet king crab larvae is not available for the Bering Sea, Adak or Dutch Harbor stocks.

Early Juvenile
Level 0. Information to define essential habitat for early juvenile scarlet king crabs is not available for the Bering Sea, Adak or Dutch Harbor stocks.

Late Juvenile

Level 0. Information to define essential habitat for late juvenile scarlet king crabs is not available for the Bering Sea, Adak or Dutch Harbor stocks.

Mature

Level 1. Essential habitat for mature scarlet king crabs is based on the general distribution (level 1) of mature golden king crabs. Mature scarlet king crabs are caught incidentally in the golden king crab and *C. tanneri* fisheries.

SPECIES: Scarlet king crab, *Lithodes couesi*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs 0								
Larvae 0								
Juveniles 0								
Adults 0								

See table of contents for the following maps:

Scarlet king crab eggs

Scarlet king crab matures

Habitat Description for Tanner crab
Chionoecetes bairdi

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Tanner crab (*Chionoecetes bairdi*) are distributed on the continental shelf of the North Pacific Ocean and Bering Sea from Kamchatka to Oregon. Off Alaska, Tanner crab are concentrated around the Pribilof Islands and immediately north of the Alaska Peninsula, and are found in lower abundance in the Gulf of Alaska. Size at 50% maturity, as measured by carapace width, is 11 cm for males and 9 cm for females in the Bering Sea. The corresponding age of maturity for male Tanner crab is approximately 6 years. Mature male Tanner crabs may skip a year of molting as they attain maturity. Natural mortality of adult Tanner crab is estimated at about 25% per year (M=0.3).

Fishery

The Tanner crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 foot square) set on single lines. Mean age at recruitment is 8-9 years to the fishery. Male crab >14 cm carapace width may be harvested. Fisheries operate on 3 separate stocks: eastern Bering Sea, eastern Aleutian Islands, and western Aleutian Islands. The directed fishery was closed in 1996 due to low CPUE relative to pre-season expectations. The Tanner crab stocks of the Aleutian Islands are very small, and populations are found in only a few large bays and inlets. As such, the fisheries are limited, occurring during the winter. No commercial fishery was allowed for Tanners in either the east or west Aleutian Island in 1995 and 1996. The directed fishery for Bering Sea Tanner crab opens seven days after closure of the Bristol Bay red king crab fishery. However, retention of Tanner crab is allowed during the Bristol Bay red king crab fishery that opens November 1. Bycatch in the directed fishery is comprised primarily of non-legal Tanner crab and red king crab. A 3" maximum tunnel height opening for Tanner crab pots is required to inhibit the bycatch of red king crab. Also, escape rings are required to reduce capture and handling mortality of all non-target crab; a minimum of four 5.0" rings are required on pots used in Tanner crab fisheries.

Relevant Trophic Information

Pacific cod is the main predator on Tanner crabs in terms of biomass. Predators consume primarily age 0 and 1 juvenile Tanner crab less than 7 cm carapace width. However, flathead sole, rock sole and yellowfin sole are important in terms of numbers of small crab. Larval predators include salmon, herring, jellyfish and chaetognaths. There is cannibalism among juvenile crabs during molting.

Describe any potential gear impacts on the habitats of this or other species

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

What is the approximate upper size limit of juvenile fish (in cm)?

The size of 50% maturity is 9 and 11 cm carapace width for female and male crabs.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Larry Boyle, 907-581-1219
ADF&G, Kodiak, AK, Al Spalinger, 907-486-1840

Habitat and Biological Associations Narrative

Egg

Level 0,1, & 2. See mature. Essential habitat for eggs is known for the stocks of *C. bairdi* Tanner crabs in Bristol Bay and the Pribilof Islands based on general distribution (level 1) and density (level 2) of egg bearing female crabs. Essential habitat for eggs of the Eastern Aleutian *C. bairdi* Tanner crab stock is based on general distribution (level 1) of the egg bearing females. Essential habitat for eggs is unknown for the Western Aleutian *C. bairdi* Tanner crab stock.

Larvae

Level 0 & 1. Larvae of *C. bairdi* Tanner crabs are typically found in Bering Sea Aleutian Island water column from 0 – 100 m in early summer. They are strong swimmers and perform diel migrations in the water column (down at night). They usually stay near the depth of the chlorophyll maximum during the day. The last larval stage settles onto the bottom mud. Essential habitat of *C. bairdi* Tanner crab larvae is based on general distribution (level 1) for the Bristol Bay and Pribilof Islands stocks. Information is not available to define essential habitat for larval *C. bairdi* Tanner crab in the Eastern Aleutian and Western Aleutian stocks.

Early Juvenile

Level 0 & 1. Early juvenile *C. bairdi* Tanner crabs occur at depths of 10 - 20 m in mud habitat in summer and are known to borrough or associate with many types of cover. Early juvenile *C. bairdi* Tanner crabs are not easily found in winter. Essential habitat of early juvenile *C. bairdi* Tanner crabs is identified by the general distribution (level 1) of this life stage for the Bristol Bay, Pribilof Islands, and Eastern Aleutian stocks. Information to identify essential habitat of early juvenile *C. bairdi* Tanner crabs in not available for the Western Aleutian stock.

Late Juvenile

Level 0, 1 & 2. The preferred habitat for late juvenile *C. bairdi* Tanner crabs is mud. Late juvenile Tanner crab migrate offshore of their early juvenile nursery habitat. Essential habitat of late juvenile *C. bairdi* Tanner crabs is based on the general distribution (level 1) and density (level 2) of this life stage for the Bristol Bay, Pribilof Islands, and Eastern Aleutian stocks. Information to identify essential habitat of late juvenile *C. bairdi* Tanner crabs in not available for the Western Aleutian stock.

Mature

Level 1 & 2. Mature *C. bairdi* Tanner crabs migrate inshore and mating is known to occur February through June. Mature female *C. bairdi* Tanner crabs have been observed in high density mating aggregations, or pods, consisting of hundreds of crabs per mound. These mounds may provide protection from predators and also attract males for mating. Mating need not occur every year, as female *C. bairdi* Tanner crabs can retain viable sperm in spermathecae up to 2 years or more. Females carry clutches of 50,000 to 400,000 eggs and nurture the embryos for one year after fertilization. Primiparous females may carry the fertilized eggs for as long as 1.5 years. Brooding occurs in 100-150 m depths. Essential habitat is based on the general distribution (level 1) and density (level 2) of mature *C. bairdi* Tanner crabs of the Bristol Bay, Pribilof Islands, and Eastern Aleutian stocks. Essential habitat of mature *C. bairdi* Tanner crabs is identified as the general distribution (level 1) for the Western Aleutian stock.

SPECIES: Tanner crab, *Chionoecetes bairdi*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs 1	1 year	NA	April-March	NA	NA	NA	F	
Larvae 0	2 to 7 mo.	Diatoms Algae Zooplankton	Summer	MCS, ICS	P	NA	F	
Juveniles 1	1 to 6 years	Crustaceans polychaetes mollusks diatoms algae hydroids	All year	MCS, ICS, BAY, BCH	D	M	F	
Adults 1	6+ years	Polychaetes crustaceans mollusks hydroids alsae diatoms	Spawning Jan. To June (peak April-May)	MCS, ICS	D	M	F	

See table of contents for the following maps:

Tanner crab eggs

Tanner crab larvae

Tanner crab early juveniles

Tanner crab late juveniles and matures

Habitat Description for Snow crab
Chionoecetes opilio

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

Snow crabs (*Chionoecetes opilio*) are distributed on the continental shelf of the Bering Sea, Chukchi Sea, and in the western Atlantic Ocean as far south as Maine. Snow crab are not present in the Gulf of Alaska. In the Bering Sea, snow crabs are common at depths less than 200 meters. The eastern Bering Sea population within U.S. waters is managed as a single stock, however, the distribution of the population extends into Russian waters to an unknown degree. While 50% of the females are mature at 5 cm carapace width, the mean size of mature females varies from year to year over a range of 6.3 cm to 7.2 cm carapace width. Females cease growing with a terminal molt upon reaching maturity, and rarely exceed 8 cm carapace width. The median size of maturity for males is 6.5 cm carapace width (approximately 4 years old). Males larger than 6 cm grow at about 2 cm per molt, up to an estimated maximum size of 14.5 cm carapace width, but individual growth rates vary widely. Natural mortality of adult snow crab is estimated at about 25% per year (M=0.3).

Fishery

The snow crab fishery is prosecuted using mesh covered pots (generally 7 or 8 foot square) set on single lines. Male only crab greater than 7.8 cm carapace width may be harvested, however a market minimum size of about 10.2 cm carapace width is generally observed. Most male snow crab are thought to enter the fishery at around age 6. Snow crab are thought to be one stock in the Bering Sea. The season opening date is January 15. A 3" maximum tunnel height opening for snow crab pots is required to inhibit the bycatch of red king crab. A minimum of four 3.75" escape rings are required on snow crab pots to reduce capture and handling mortality of non-target crab. Bycatch in the snow crab fishery is comprised primarily of *C. bairdi* and non-legal *C. opilio*.

Relevant Trophic Information

Pacific cod, sculpins, and pollock are the main predator on snow crabs in terms of biomass. Snow crabs less than 7 cm carapace width are most commonly consumed. Other predators include yellowfin sole, flathead sole, Alaska plaice, walleye pollock, Pacific halibut, rock sole, skates, bearded seals and walrus. Juvenile snow crabs are cannibalistic during molting.

Describe any potential gear impacts on the habitats of this or other species

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

What is the approximate upper size limit of juvenile fish (in mm)?

The size of 50% maturity is 5 and 6.5 cm carapace width for female and male crabs.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK, Rance Morrison, 907-581-1239
ADF&G, Dutch Harbor, AK, Larry Boyle, 907-581-1239

Habitat and Biological Associations Narrative

Egg
Level 2. See Mature. Essential habitat for eggs is known for the stocks of *C. opilio* snow crabs in the Eastern Bering Sea based on general distribution (level 1) and density (level 2) of egg bearing female crabs.

Larvae
Level 1. Larvae of *C. opilio* snow crab are found in early summer and exhibit diel migration. The last of 3 larval stages settles onto bottom in nursery areas. Essential habitat is based on general distribution (level 1) of *C. opilio* snow crab larvae of the Eastern Bering Sea stock.

Early Juvenile
Level 1. Shallow water areas of the Eastern Bering Sea are considered nursery areas for *C. opilio* snow crabs and are confined to the mid-shelf area due to the thermal limits of early and late juvenile life stages. Essential habitat is identified as the general distribution (level 1) of early juvenile crabs of the Eastern Bering Sea stock of *C. opilio* snow crabs.

Late Juvenile
Level 2. A geographic cline in size of *C. opilio* snow crabs indicates a large number of morphometrically immature crabs occur in shallow waters less than 80 m. Essential habitat is based on the general distribution (level 1) and density (level 2) of juvenile crabs of the Eastern Bering Sea stock of *C. opilio* snow crabs.

Mature
Level 2. Female *C. opilio* snow crabs are acknowledged to attain terminal molt status at maturity. Primiparous female snow crabs mate January through June and may exhibit longer egg development period and lower fecundity than multiperous female crabs. Multiparous female snow crabs are able to store spermatophores in seminal vesicles and fertilize subsequent egg clutches without mating. At least two clutches can be fertilized from stored spermatophores, but the frequency of this occurring in nature is not known. Females carry clutches of approximately 36,000 eggs and nurture the embryos for approximately one year after fertilization. However, fecundity may decrease up to 50% between the time of egg extrusion and hatching presumably due to predation, parasitism, abrasion or decay of unfertilized eggs. Brooding probably occurs in depths greater than 50 m. Changes in proportion of morphometrically mature crabs by carapace width have been related to an interaction between cohort size and depth.

SPECIES: Snow crab, *Chionoecetes opilio*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs 1	1 year	NA		NA	NA	NA	F	
Larvae 0	2 to 7 mo.	Diatoms algae zooplankton	Spring, summer	ICS, MCS	P	NA	F	
Juveniles 1	1 to 4 years	Crustaceans polychaetes mollusks diatoms algae hydroids	All year	ICS, MCS, OCS	D	M	F	
Adults 1	4+ years	Ploychaetes brittle stars mollusks crustaceans hydroids algae diatoms	Spawning Jan. To June (peak April-May)	ICS, MCS, OCS	D	M	F	

See table of contents for the following maps:

Snow crab eggs

Snow crab larvae

Snow crab early juveniles

Snow crab late juveniles

Snow crab matures

Habitat Description for Grooved Tanner crab
Chionoecetes tanneri

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

In the eastern North Pacific Ocean the grooved Tanner crab (*Chionoecetes tanneri*) ranges from northern Mexico to Kamchatka. Little information is available on the biology of the grooved Tanner crab. This species occurs in deep water and not common at depth <300 m. Male and female crabs are found at similar depths. Male and female grooved Tanner crab generally reach maturity at 11.9 cm and 7.9 cm carapace width, respectively.

Fishery

Directed harvest of grooved Tanner crab has been sporadic since first reported landings in 1988. Crabs are taken in mesh covered pots deployed on a longline. Harvest can occur only under conditions of a permit issued by the Commissioner of Fish and Game.

Relevant Trophic Information

Describe any potential gear impacts on the habitats of this or other species

What is the approximate upper size limit of juvenile fish (in cm)?

Size at 50% maturity is 11.9 cm carapace width for males and 7.9 cm for females.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK., Larry Boyle, Rance Morrison 907-581-1219

Habitat and Biological Associations Narrative

Egg
Level 0. Information to define essential habitat for grooved Tanner crab eggs is not available for the Bering Sea, Eastern Aleutian or Western Aleutian stocks.

Larvae
Level 0. Information to define essential habitat for larvae of grooved Tanner crabs is not available for the Bering Sea, Eastern Aleutian or Western Aleutian stocks.

Early Juvenile
Level 0. Information to define essential habitat for early juvenile grooved Tanner crabs is not available for the Bering Sea, Eastern Aleutian, or Western Aleutian stocks.

Late Juvenile

Level 0. Information to define essential habitat for late juvenile grooved Tanner crabs is not available for the Bering Sea, Eastern Aleutian, or Western Aleutian stocks.

Mature

Level 1. In the Eastern Bering Sea mature male grooved Tanner crabs may be found somewhat more shallow than mature females but male and female crabs don't show clear segregation by depth. General distribution (level 1) of mature grooved Tanner crabs is used to identify essential habitat of the Bering Sea, Eastern Aleutian, and Western Aleutian stocks.

SPECIES: Grooved Tanner crab, *Chionoecetes tanneri*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs								
Larvae								
Juveniles								
Adults		Polychaetes, crustaceans, ophiuroids						

See table of contents for the following maps:

Grooved Tanner crab eggs

Grooved Tanner crab matures

Habitat Description for Triangle Tanner crab
Chionoecetes angulatus

Management Plan and Area(s)

Fishery management plan for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands

Life History and General Distribution

In the eastern North Pacific Ocean the distribution of triangle Tanner crab (*Chionoecetes angulatus*) ranges from Oregon to the Sea of Okhotsk. This species occurs on the continental slope in waters >300 m and has been reported as deep as 2,974 m in the Eastern Bering Sea. A survey limited in depth found mature male crabs inhabit depths around 647 m shallower than the mean depth of 748 m for female crabs. Size at 50% maturity for male triangle Tanner crabs is 9.1 cm carapace width and 5.8 cm for females.

Fishery

A directed fishery for triangle Tanner crab was documented for the first time in 1995. Prior to 1995, these crab had been harvested as bycatch in the *C. tanneri* fishery. Directed harvest is allowed only under the conditions of a permit issued by the Commissioner of Fish and Game. Crab are taken in mesh covered pots deployed on a longline.

Relevant Trophic Information

Describe any potential gear impacts on the habitats of this or other species

What is the approximate upper size limit of juvenile fish (in cm)?

In the eastern Bering Sea, male triangle Tanner crabs reach size at 50% maturity at 9.1 cm carapace width and females at 5.8 cm.

Source (agency, name and phone number, or literature reference) for additional distribution data

ADF&G, Dutch Harbor, AK., Larry Boyle, Rance Morrison 907-581-1219

Habitat and Biological Associations Narrative

Egg

Level 0. Information to define essential habitat for triangle Tanner crab eggs is not available for the Bristol Bay or Eastern Aleutian stocks. General distribution (level 1) of mature triangle Tanner crabs is used to identify essential habitat of the Bristol Bay and Eastern Aleutian stocks.

Larvae

Level 0. Information to define essential habitat for larvae of triangle Tanner crabs is not available for the Bristol Bay or Eastern Aleutian stocks.

Early Juvenile

Level 0. Information to define essential habitat for early juvenile triangle Tanner crabs is not available for the Bristol Bay or Eastern Aleutian stocks.

Late Juvenile

Level 0. Information to define essential habitat for late juvenile triangle Tanner crabs is not available for the Bristol Bay or Eastern Aleutian stocks.

Mature

Level 1. The mean depth of mature male triangle Tanner crabs (647 m) is significantly less than for mature females (748 m) indicating some pattern of sexual segregation by depth. General distribution (level 1) of mature triangle Tanner crabs is used to identify essential habitat of the Bristol Bay and Eastern Aleutian stocks.

SPECIES: Triangle Tanner crab, *Chionoecetes angulatus*

Stage - EFH Level	**Duration or Age**	**Diet/Prey**	**Season/Time**	**Location**	**Water Column**	**Bottom Type**	**Oceano-graphic Features**	**Other**
Eggs								
Larvae								
Juveniles								
Adults								

See table of contents for the following maps:

Triangle Tanner crab eggs

Triangle Tanner crab matures

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RESEARCH NEEDS

As a first step to identify the most productive habitat types for each life stage of Bering Sea and Aleutian Islands king, Tanner and snow crabs, several analyses of existing data would be useful.

(1) Analyze trawl survey data to evaluate co-occurrence of crabs with flora, fauna, invertebrate and vertebrate species by survey station and year.
(2) Evaluate co-occurrence relative to changes in mature crab abundance and time lagged abundance as an index of recruitment.
(3) Investigate species interchange and niche displacement over time relative to crab and groundfish abundance by area.
(4) Evaluate relative crab and groundfish abundance by statistical area over time relative to intensity of commercial fishing effort.

Equally important is to ground truth assumed crab habitat associations by life stage and in so doing initiate regular surveys using appropriately scaled tools for the target sample space (e.g. oblique bongo tows, crab collectors, diver/submersible observation, beam trawl, and laser line scan). Regular survey allows estimation of prey usage, growth, reproductive potential and potentially natural and fishing mortality. Given the temporal nature of crab in time and space, multiple surveys spread throughout the year are important. Areas to focus survey sampling would include:

(1) Established habitats associated with each life stage of crab by species.
(2) Probable habitats for crab species and life stages of unknown habitat.
(3) Known commercial fishing locations to assess abundance of bottom dwelling species and area of habitat types before and after a concentration of fishing gear occurs in the area.

Crabs exhibit a number of migratory behaviors throughout their life stages. Imperative to understanding changes in crab habitat association within a year and from life stage to life stage is development of scaled to size tags that can be retained through molt. To date, no such tag exists for mature Chionoecetes crabs. Integral to a crab tagging program is sufficient technological support to track and recover tags.

REPORT PREPARATION

Members of the Bering Sea/Aleutian Islands (BSAI) EFH Crab Technical Team who compiled this report were Jerry Reeves (NMFS), David Witherell (NPFMC), Peggy Murphy (ADF&G), and Matt Eagleton (NMFS). The preliminary report was compiled by the technical team for review by the core team in July 1997. The report was reviewed and updated on February 18-19, 1998 at a public meeting at the NMFS Alaska Regional Office. Additional assistance was provided at that time by Chuck O'Clair (NMFS), Bob Stone (NMFS), and Dan Urban (ADF&G) during coincident discussion of crab habitat in the Gulf of Alaska. The preliminary report was distributed to the Council crab plan team for review in August 1997 and again in March 1998. During review in March 1998, the crab plan team contributed extensive detail to complete summary of crab habitat associations, life histories and maps based on their collective knowledge. Members of the crab plan team are Rance Morrison, Peggy Murphy, Bob Otto, Doug Pengilly, Jerry Reeves, Kim Rivera, Tom Shirley, Al Spalinger, and David Witherell.